

**Committee on Science  
Subcommittee on Space and Aeronautics  
U.S. House of Representatives  
Hearing Charter**

***NASA-DoD Cooperation in Space Transportation*  
Thursday, March 18, 2004  
1:00 p.m.  
2318 Rayburn House Office Building**

**I. Purpose**

The House Subcommittee on Space and Aeronautics will hold a hearing entitled *NASA-DoD Cooperation in Space Transportation* on Thursday, March 18, 2004, at 1:00 p.m. in room 2318 of the Rayburn House Office Building.

The Department of Defense (DoD) and the National Aeronautics and Space Administration (NASA) both depend on rockets manufactured by private sector contractors to launch payloads into orbit – payloads such as reconnaissance satellites, weather satellites, or scientific instruments that are necessary for national security or to carry out research in space. This hearing will explore whether better coordination between NASA and DoD in developing and purchasing rockets could increase the reliability and lower the cost of launch vehicles. The hearing will also explore how DoD and NASA could encourage the emergence of new, entrepreneurial companies that can launch payloads into space.

The hearing will explore the following questions:

- (1) To what extent can NASA and the DoD benefit from greater cooperation in the development and purchasing of launch vehicles?
- (2) What steps is NASA taking to collaborate with the DoD in order to realize those benefits?
- (3) What areas of launch vehicle development are exclusively the role and responsibility of one agency or the other?
- (4) To what extent can NASA and the DoD encourage the growth of the U.S. domestic launch market, including emerging U.S. launch vehicle providers who provide unique capabilities?

**II. Witnesses**

- **Rear Admiral (Ret.) Craig Steidle**, NASA Associate Administrator for the Office of Exploration Systems, is responsible for developing NASA's new launch vehicles. Prior to joining NASA, RADM Steidle was Vice Commander of Naval Air Systems and Director of the Joint Strike Fighter Program.
- **Major General (Ret.) Robert Dickman**, Deputy for Military Space in the Office of the Under Secretary of the Air Force, manages the planning, programming, and acquisition of Air Force space systems. Maj. Gen Dickman previously commanded the launch wing at Patrick Air Force Base, Florida.

- **The Honorable Ron Sega**, Director of Defense Research & Engineering, is the chief technical adviser to the Secretary of Defense for all scientific and technical matters, basic and applied research, and advanced technology development. A veteran of two NASA Space Shuttle missions, Dr. Sega also serves as a major general in the Air Force reserves.
- **Mr. Elon Musk**, Chief Executive Officer of Space Exploration Technologies or SpaceX, is developing a new, privately-financed family of launch vehicles intended to reduce the cost and increase the reliability of access to space. Previously, Mr. Musk co-founded and was the largest shareholder of PayPal, a company that developed an internet electronic payment system that was sold for \$1.5 billion in October 2002.

### III. Brief Overview

- **The Department of Defense (DoD) and the National Aeronautics and Space Administration (NASA) each contract with industry to build the rockets, or launch vehicles, needed to launch each agency's payloads into orbit.** For example, from the 1950s through the 1990s, the DoD funded the development of the Atlas, Delta and Titan families of rockets to lift payloads such as reconnaissance satellites of varying sizes into orbit. Used once and then discarded, these rockets are known as expendable launch vehicles (ELVs). NASA's Apollo program designed the Saturn rocket, which was also expendable, to carry very heavy payloads to the Moon. In the 1970s, NASA developed the Space Shuttle, the world's first and only reusable launch vehicle. (While the Space Shuttle was originally intended to be wholly reusable, the version ultimately built is only partially reusable, as the large, orange-colored external tank is used only once.) The government developed these launch vehicles through contracts with various aerospace contractors, the largest of which today are the Boeing Company and the Lockheed Martin Corporation.
- **The domestic launch industry has suffered economically from the recent decline in demand for commercial launches, making the costs of these rockets more expensive.** In addition to serving the government's launch needs, aerospace companies also serve the commercial launch market. For example, satellite telecommunication companies purchase launches from commercial launch vehicle providers to carry their communications satellites into orbit. However, while the government's demand for launch vehicles from aerospace companies has remained steady, the private sector's demand has dropped precipitously in recent years (due in large part to the use of fiber optics and cellular technologies). This sharp downturn in the commercial launch vehicle market increases the prices that commercial providers charge NASA and the DoD. For the past decade or so, U.S. aerospace companies have also faced increasing competition from foreign launch companies, particularly Arianespace, which is partially owned by European governments.
- **The President's new space exploration initiative will require NASA to use more expendable launch vehicles after 2010, which may provide new opportunities for greater coordination with DoD.** The vision for NASA that the President announced on January 14<sup>th</sup> calls for NASA to retire the Shuttle after assembling the International Space Station, now targeted for completion by 2010. After that, NASA must decide whether it will develop a new heavy-lift expendable rocket, convert the Shuttle (which is a heavy-lift vehicle) into a configuration designed to carry only cargo, or use or modify existing expendable launch vehicles, which are not capable of launching the heaviest loads. The

vision also calls for NASA to develop a new Crew Exploration Vehicle (CEV) to carry humans back to the Moon as early as 2015. Such a vehicle would most likely be lifted into orbit on an expendable launch vehicle. Any existing rocket probably would have to be modified to be rated as safe for humans.

- **NASA and the DoD have had mixed success when collaborating on launching payloads into orbit and on developing new technologies.** Some NASA and DoD collaborations have produced spectacular successes. For example, in 1947 the Bell X-1 experimental vehicle (flown by Chuck Yeager) was operated by the Air Force and designed by NASA's predecessor agency, the National Advisory Committee for Aeronautics. On the other hand, the Space Shuttle itself is an example of a collaboration that did not work out as originally intended. Meeting both NASA and DoD requirements made it more difficult and more costly to design, build and operate the Shuttle. Moreover, eventually the Shuttle proved to be too risky for DoD to use. In 1986, when the entire Shuttle fleet was grounded for 32 months in the wake of the *Challenger* accident, DoD was unable to launch critical national security satellites. Partly as a result, DoD stopped using the Shuttle to launch its national security payloads and turned solely to expendable rockets.
- **New entrants in the domestic launch industry have the potential to lower costs, and increase reliability.** Some relatively new companies are beginning to produce new launch vehicles for the commercial sector and for government. One such company, SpaceX, has said that its goal is to reduce the cost and increase the reliability of launching payloads into space by a factor of ten. DoD awarded SpaceX a contract to launch a research satellite this May on its new Falcon I rocket. NASA has been unwilling to consider making an award to SpaceX, saying that NASA will only launch on types of rockets that have already had at least one successful launch. However, NASA has recently announced its intent to award a contract to Kistler Aerospace Corporation to demonstrate the company's reusable launch vehicle that someday could carry cargo to the International Space Station. (The contract is contingent on Kistler emerging from bankruptcy.)
- **The White House is preparing to update the government's space transportation policy, which is expected to specify the roles DoD and NASA should play in developing future space launch systems.** In 1994, the Clinton Administration issued a National Space Transportation Policy to delineate the roles DoD and NASA would each play in developing new space launch vehicles. Under the 1994 policy, NASA was to concentrate on developing and demonstrating reusable vehicle technology, while the DoD would focus exclusively on expendable launch vehicles. In 2002, the Bush Administration directed the National Security Council to review this policy due to NASA's failure to develop and demonstrate reusable vehicle technology and the downturn in the commercial, expendable launch vehicle market that affected the government's costs. The release of the Administration's new space transportation policy has been delayed due to the Space Shuttle *Columbia* accident, but it is expected later this year. The new space transportation policy is expected to reflect the Administration's space exploration policy objectives.

#### IV. Issues

- **What are the benefits and drawbacks of NASA and DoD cooperating on developing and purchasing launch vehicles?** Cooperation between NASA and DoD can lead either to lower costs -- or to a proliferation of requirements and higher costs, depending on the situation. Cooperation can also either be an acknowledgement of areas where the two agencies' needs and missions overlap -- or an improper merging of distinct missions. Congress and the agencies need to figure out how to decide when cooperation is optimal and when it might be harmful.
- **How can the government better encourage the sustainable growth of the domestic launch industry?** Greater cooperation between NASA and the DoD in developing and purchasing rockets might also benefit the industry by increasing demand for those rockets used by both agencies. A healthy domestic launch industry is important for both NASA and the DoD. But NASA has not yet decided what kinds of launch vehicles it will need for either crew or cargo after it retires the Shuttle and, as mentioned above, cooperation between the two agencies is not always appropriate.
- **How can the government foster the entry of new, innovative launch companies to meet the government's needs?** Both DoD and NASA could benefit from the entry of new companies into the launch vehicle market, especially since such companies promise lower costs and greater reliability. However, using these companies also presents a greater level of risk to the agencies because the companies' technology is unproven. The agencies need to balance the need to encourage emerging companies against the need to carry out agency missions with limited risk.

#### V. Background

##### *History of NASA and DoD Space Transportation Development Efforts*

The DoD funded the development of the Atlas, Delta, and Titan families of ELVs (called expendable because they can only be used once) based on ballistic missile technology from the 1950s-60s. In the 1960s, NASA developed the small Scout rocket and the heavy-lift Saturn rockets, both of which are no longer produced. Today, the Boeing Company manufactures the Delta family of expendable launch vehicles and is part of the Sea Launch joint venture with the Russian/Ukrainian Zenit rocket. Lockheed Martin manufactures the Atlas, Athena, and Titan launch vehicles, and Orbital Sciences Corporation manufactures the smaller Pegasus and Taurus launch vehicles. Both Boeing and Lockheed Martin build portions of NASA's Space Shuttle, and both companies own equal portions of the United Space Alliance (USA), which manages Shuttle operations and maintenance.

During the 1980s and early 1990s, NASA and DoD worked together on an ultimately unsuccessful effort to develop a new reusable launch vehicle to replace the Shuttle, as well as new expendable launch vehicles. These programs failed because of a combination of technical failures and problems with funding. One unsuccessful effort to create a reusable vehicle was the X-30 or National Aerospace Plane project initiated by President Reagan.

The project was doomed by insurmountable technical hurdles with hypersonic technology and was also affected by the end of the Cold War, which made moot some of the impetus for the project. At the same time, NASA and DoD initiated expendable launch vehicle programs. Those programs—Advanced Launch System, National Launch System, and Spacelifter—were not sustained by either the agencies or the Congress for long enough to fully develop any new system.

President Clinton issued a National Space Transportation Policy in 1994 that designated lead responsibility for improving expendable launch vehicles to DoD and lead responsibility for upgrading the Space Shuttle and technology development of new reusable launch vehicles to NASA.

The 1994 policy directed NASA to conduct research designed to demonstrate by the year 2000 a rocket engine that could fly to orbit using only a single stage (rather than the multiple-stage rockets that are used today). In response, NASA began two experimental flight test programs in 1995, the X-33 (with Lockheed Martin) and X-34 (with Orbital Sciences). Neither program was able to successfully demonstrate a vehicle, and NASA terminated both programs in March 2001. NASA had spent approximately \$1.2 billion on the X-33 and \$205 million on the X-34 by the time the programs were cancelled. Lockheed Martin said that it had spent \$356 million of its own money on the X-33.

At the same time, the 1994 policy directed the DoD to work with industry to modernize or “evolve” the expendable launch vehicle fleet under the Evolved Expendable Launch Vehicle (EELV) program “to reduce costs while improving reliability, operability, responsiveness, and safety.” The policy also directed the U.S. Government to meet its future launch needs by purchasing commercial launch services.

In 1995, DoD began funding the development of the latest generation of Delta and Atlas launch vehicles through the EELV program. Under that program, DoD has awarded contracts to Boeing valued at \$1.88 billion (\$500 million for development plus \$1.38 billion for 19 launches) for the Delta IV, and contracts to Lockheed Martin valued at \$1.15 billion (\$500 million for development plus \$650 million for 9 launches) for the Atlas V. EELV contracts were awarded to both companies to ensure that DoD would not be forced to rely on a single supplier. Each company has spent about \$1 billion of its own money on EELV development. DoD also has a variety of other programs to develop new launch vehicles and vehicle components.

Some low-level cooperation between NASA and DoD on rocket technologies continued even under the 1994 policy, but cooperation began again in earnest around 2000. In the wake of failures in the X-33 and X-34 programs, NASA proposed the Space Launch Initiative, under which it would cooperate with DoD on both reusable and expendable launch technologies.

### *Economic Landscape for Domestic Launch Industry and Recent Developments*

DoD hoped the EELV would be less expensive to purchase than previous launch vehicles. However, that assumed a thriving commercial launch business that would add to the demand for the new rockets. Instead, the demand for commercial launches has plummeted. In 1999, 76 commercial payloads were launched, producing \$2.3 billion in launch revenues, while in

2003 only 18 commercial payloads representing \$1.2 billion were launched. Furthermore, competition has become more intense even as the number of launches has declined.

Today, both Boeing and Lockheed Martin are seeking to negotiate higher launch prices with DoD and NASA, and the agencies predict that launch costs could increase by 50 percent. DoD's efforts to keep both companies in the launch business were complicated recently when it penalized Boeing after the company was found to have used proprietary information from Lockheed Martin. The penalties included losing awards for several launches and restrictions on bidding for some future launches.

The President's space exploration initiative announced on January 14<sup>th</sup> would have a significant impact on the launch industry. While NASA does use expendable launch vehicles for some of its current needs, such as earth science satellites, NASA uses the Space Shuttle (and Russian Soyuz vehicles) to launch humans into space and uses the Space Shuttle and Russian vehicles for related cargo needs. Under the President's proposal, the Shuttle would be retired around 2010. The proposal does not say what NASA will use to take cargo to and from the International Space Station after that time or what will be used to launch payloads to the Moon or other locations. The President proposed developing a new vehicle, called the Crew Exploration Vehicle (CEV), to launch humans after the Shuttle is retired, but NASA has not yet decided what kind of rocket would lift the CEV.

As part of its FY 05 budget, NASA has proposed eliminating the Space Launch Initiative as a discrete program. NASA is in the process of deciding which elements of the Space Launch Initiative to retain (in other programs) as relevant to the President's exploration proposal. For example, NASA has already decided to cancel one joint project on advanced rocket engines and to continue a joint project to demonstrate autonomous satellite rendezvous capability.

In addition, the National Security Council is working on an inter-agency effort, begun in 2002, to develop a new space transportation policy. The policy is expected to be released later this year.

### *Emerging Commercial Launch Providers*

Space Exploration Technologies (commonly referred to as SpaceX) is a privately funded company developing a family of launch vehicles called Falcon rockets. SpaceX has said it intends to reduce launch costs ultimately by a factor of ten. The Falcon I launch vehicle is a small rocket priced at \$6 million per launch, a significant price savings compared to other comparably-sized rockets. The first launch of the Falcon I rocket, carrying a DoD research satellite, is scheduled for mid-2004.

In addition to Space X, other emerging launch providers include Kistler Aerospace and Universal Space Lines. NASA recently announced that it intends to pay Kistler Aerospace about \$227 million to demonstrate that it can carry cargo to and from the International Space Station. This contract is contingent on Kistler successfully emerging from bankruptcy.

NASA has also requested \$10 million for FY 05 to buy launch services from emerging companies. However, NASA's current launch policy forbids NASA to contract for launch services unless the type of rocket being used has performed at least one successful flight. The policy was put in place in the mid-1990s after several rockets failed on their maiden flights.

Those rockets were made by Orbital and CTA, which is no longer in business. The DoD does not have an analogous policy for its research satellites, which is why it is able to use SpaceX's new Falcon I rocket.

**VI. The witnesses were asked to respond to the following questions in their testimony before the Subcommittee:**

**Rear Admiral (Ret.) Craig Steidle**, NASA Associate Administrator for the Office of Exploration Systems, was asked to address:

- Are there any specific lessons learned from past NASA-Department of Defense (DoD) joint ventures in space transportation development and operations that NASA is applying to future programs, such as the Crew Exploration Vehicle, human-rated EELV, and heavy-lift launch vehicle?
- What are the benefits and risks to NASA from increased collaboration with the DoD in launch vehicle development and purchases to support human space flight missions and develop the next generation launch technologies?
- What steps is NASA taking to encourage the growth of the U.S. domestic launch market, including emerging commercial launch service providers to support the Space Station and launch research payloads? What risks, if any, is NASA willing to take by relying on these emerging launch providers?

**Maj Gen (Ret.) Bob Dickman**, Office of the Air Force Under Secretary, was asked to address:

- What are the benefits and risks to the Department of Defense (DoD) from increased collaboration with NASA in launch vehicle development and purchases to support DoD missions?
- What steps is the DoD taking to ensure that it leverages the potential benefits of NASA's investments to improve the capabilities of U.S. launch vehicles?
- What steps is the DoD taking to encourage the growth of the U.S. domestic launch market, including emerging commercial launch service providers to support DoD missions?

**Dr. Ron Sega**, Defense Research and Engineering, was asked to address:

- What is the status of the Administration's review of U.S. space transportation policy?
- How do NASA and the Department of Defense (DoD) coordinate their broad research portfolios for space launch vehicles? How might the DoD's launch and propulsion research and development activities contribute technologies to NASA initiatives?
- How is the DoD using emerging commercial launch vehicle providers, like SpaceX? What risks, if any, is the DoD taking by relying on these emerging launch providers?

**Mr. Elon Musk**, Space Exploration Technologies, was asked to address:

- What are the benefits and risks for the U.S. domestic launch industry, including emerging U.S. launch vehicle providers, if NASA and the Department of Defense (DoD) collaborated more in the development and purchases of launch vehicles?
- What specific recommendations would you make for how NASA and the DoD can encourage the healthy growth of the U.S. domestic launch market, especially for emerging commercial launch providers?

- What unique capabilities do emerging launch vehicle providers, like SpaceX, provide to NASA and the DoD?